Welcome to Charleston!

CCEHBR Coral Research

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NOAA NOS NCCOS
Center for Coastal Environmental Health and Biomolecular Research
Hollings Marine Laboratory
Charleston, South Carolina


NOS
Hollings
NIST
SCDNR
Grice
MBES
Ft Johnson Campus


MBES
MUSC
MEDICAL UNIVERSITY OF SOUTH CAROLINA
Grice
NIST
NIST
Hollings Marine Lab
HML
NOS/CCEHBR
NOAA
SC DNR


HOLLINGS MARINE LABORATORY
HOLLINGS MARINE LABORATORY

Laboratory Support ~32,800sq ft

- Environmental Chemistry (12,375 net sq ft)
- Molecular Biology & Physiology (11,508 net sq ft) including BSL 3 capability
- Cryogenic Storage (3,800 net sq ft) including National Marine Specimen Bank
- Aquatic Production (5,147 net sq ft) including settled and raw seawater

Science Focus

To provide the science and biotechnology to understand linkages between environmental condition of the oceans and organism and human health.

Research Initiatives

- **Emerging Chemicals of Concern:** What are the appropriate methods for measuring emerging chemicals? What are their ecotoxicological impacts (molecules to ecosystems)?

- **Marine Analytical Quality Assurance:** What reference materials and methods are needed to improve the quality of analytical measurements in the marine environment? What materials need to be cryogenically archived for looking backward at pollution trends?

Research Initiatives

- **Marine Genomics:** What genes are influenced by environmental challenges? What assays best measure organism health and exposure?

- **Acquired Environmental Resistance:** What are the sources and causes of ACR? What is the persistence of ACR in the environment? What are the environmental and health risks associated with ACR? How can these risks be limited?

Research Initiatives

- **Harmful Algae Blooms:** What are the harmful algae of concern in the for Southeastern barrier island estuaries? How to they relate to human activities on the land?

- **Natural Products Chemistry:** What is the chemical structure of biotoxic molecules and how does the structure relate to the mode of activity?

Research Initiatives

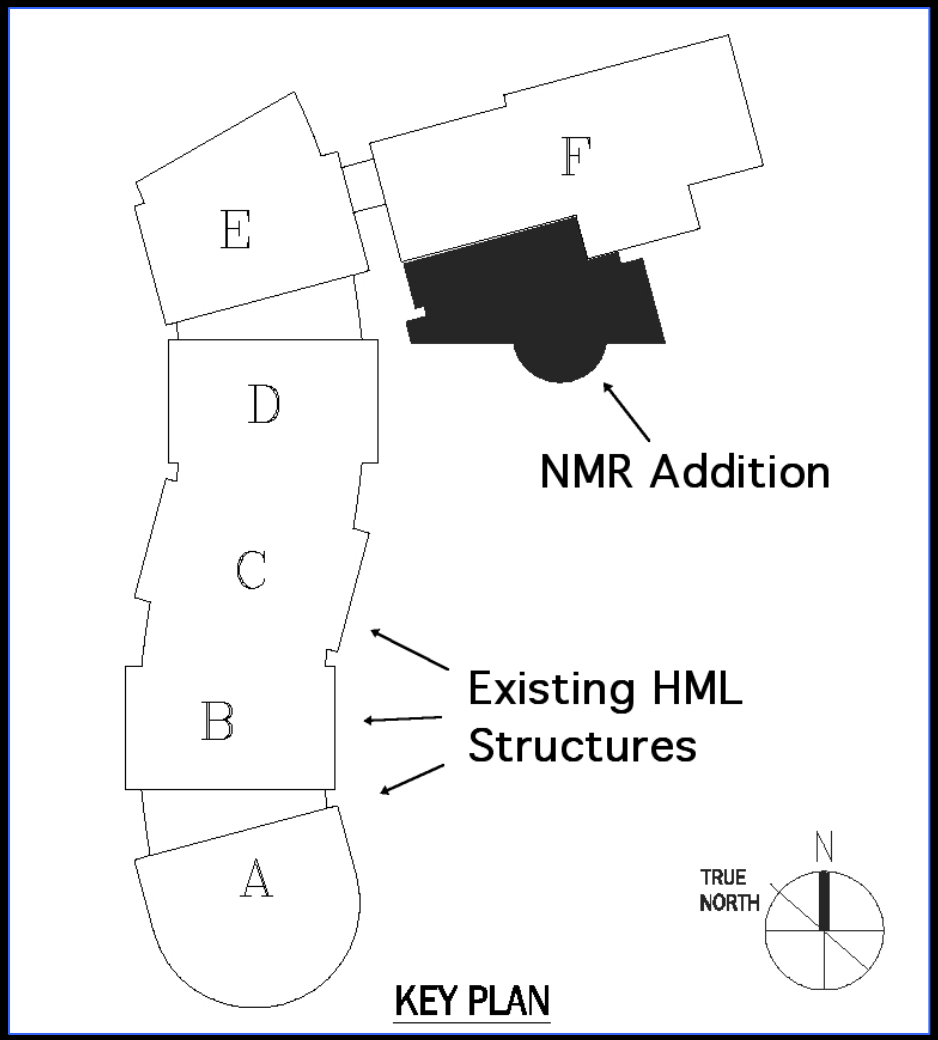
- **Animal Production & Seafood Safety:** Is stock enhancement a viable technology for restoring overfished stocks and expanding fishing opportunities? What is the appropriate method?

Research Initiatives

- **Field Validation of Indicators:** Do field responses of environmental indicators pattern laboratory responses? How can the specificity and reliability of indicator responses be improved?

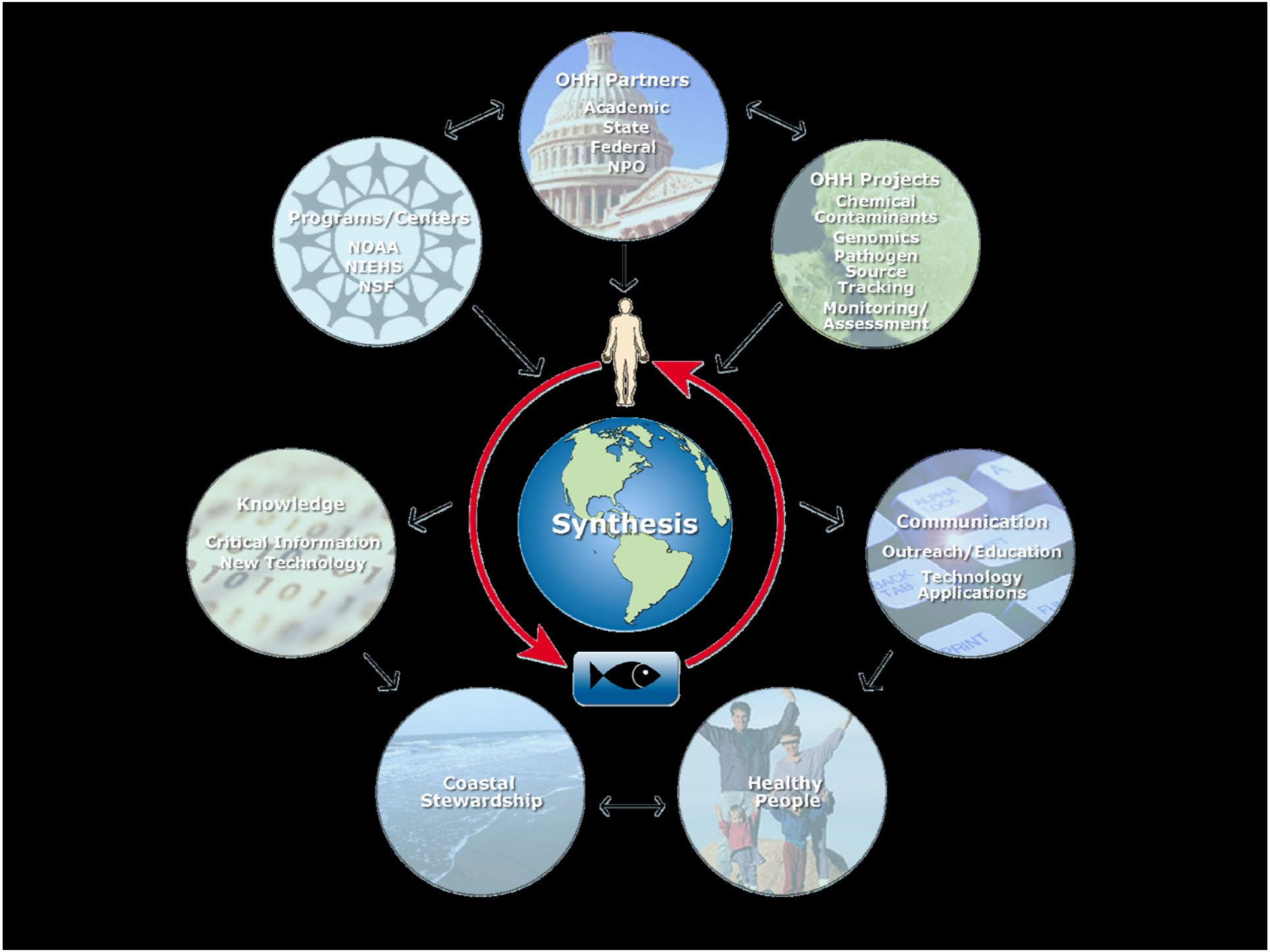
- **Synthesis and Integration:** What are the most effective and efficient technologies for synthesizing the information contained in large, complex data sets?

Nuclear Magnetic Resonance Addition



Nuclear Magnetic Resonance Addition

- Structural chemistry
- Natural products chemistry
- Cancer research
- Environmental toxicology


OHH Partners
Academic
State
Federal
NPO
Programs/Centers
NOAA
NIEHS
NSF
OHH Projects
Chemical Contaminants
Genomics
Pathogen Source Tracking
Monitoring/ Assessment
Synthesis
Knowledge
Critical Information
New Technology
Communication
Outreach/Education
Technology Applications
Coastal Stewardship
Healthy People

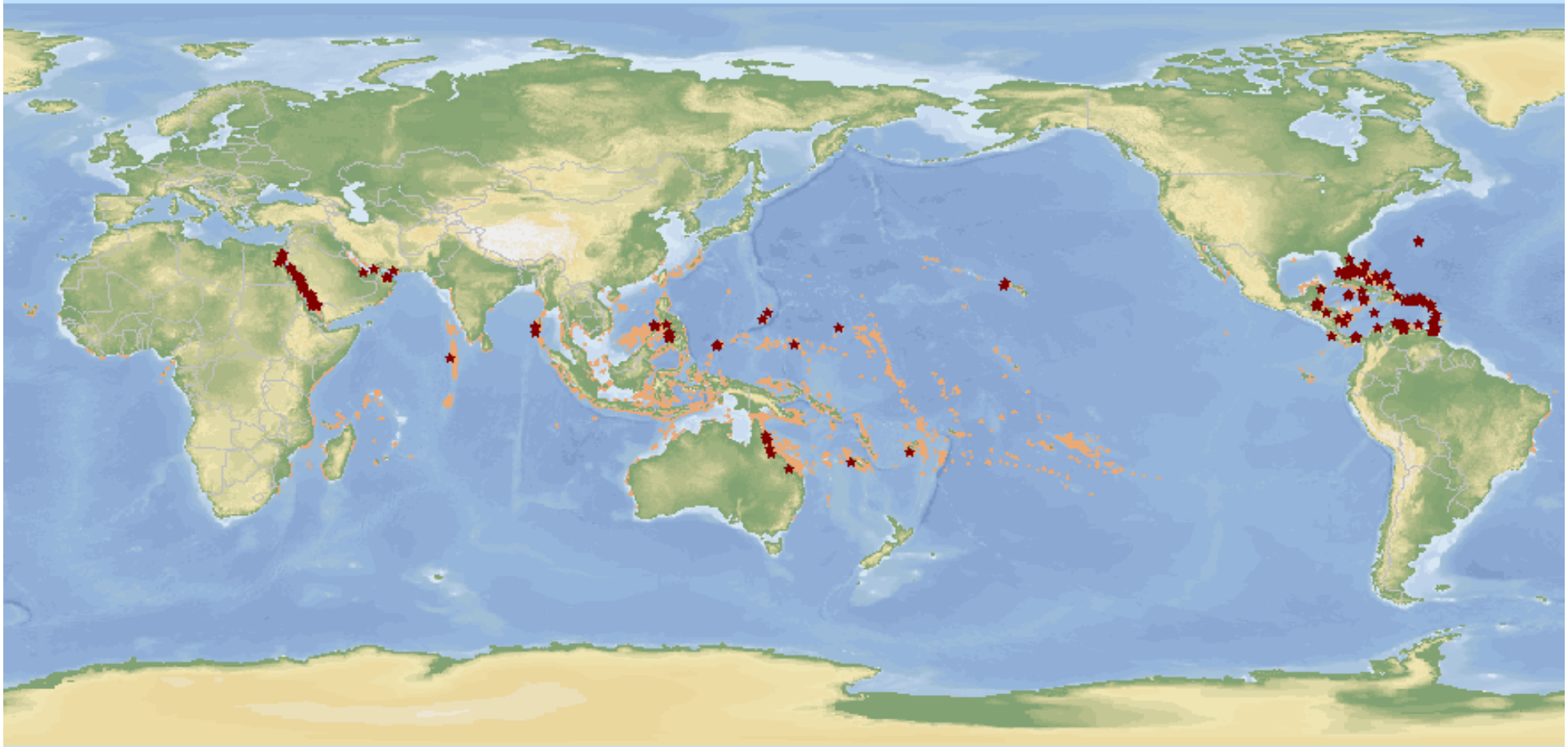
Ecosystem Health

Coral Reefs

NOS CCEHBR

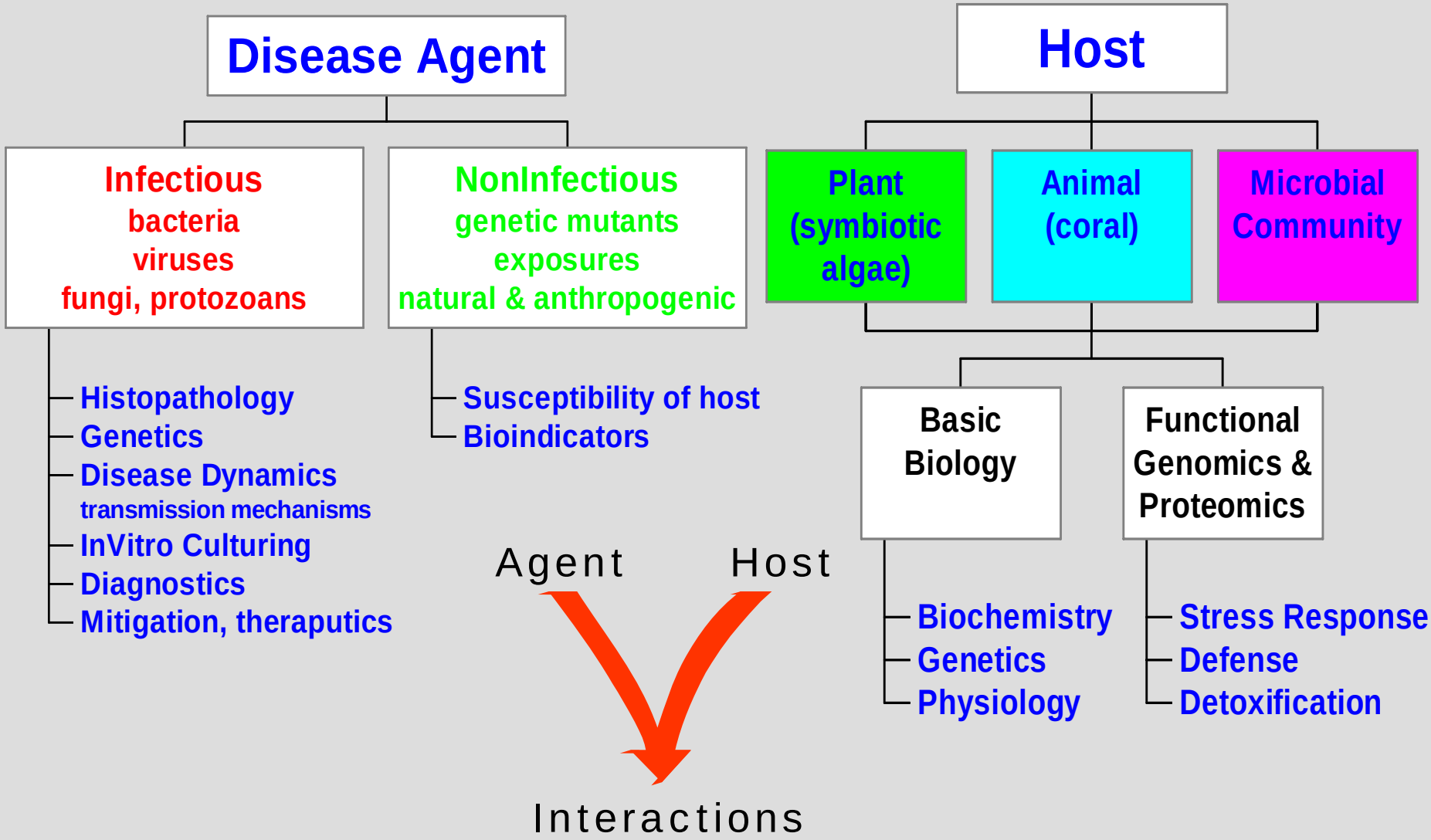
Coral Health and Disease Program

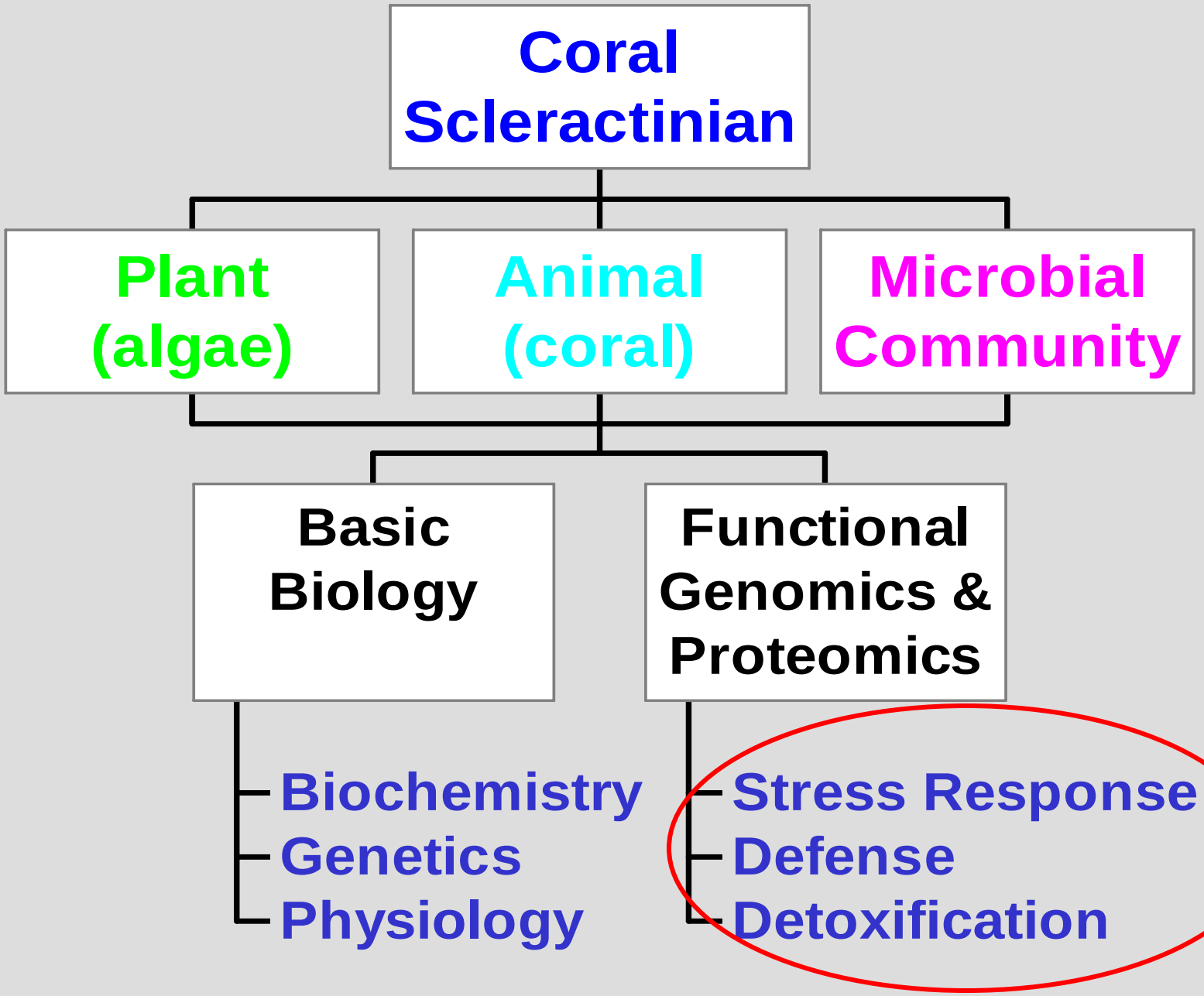
Global Coral Disease



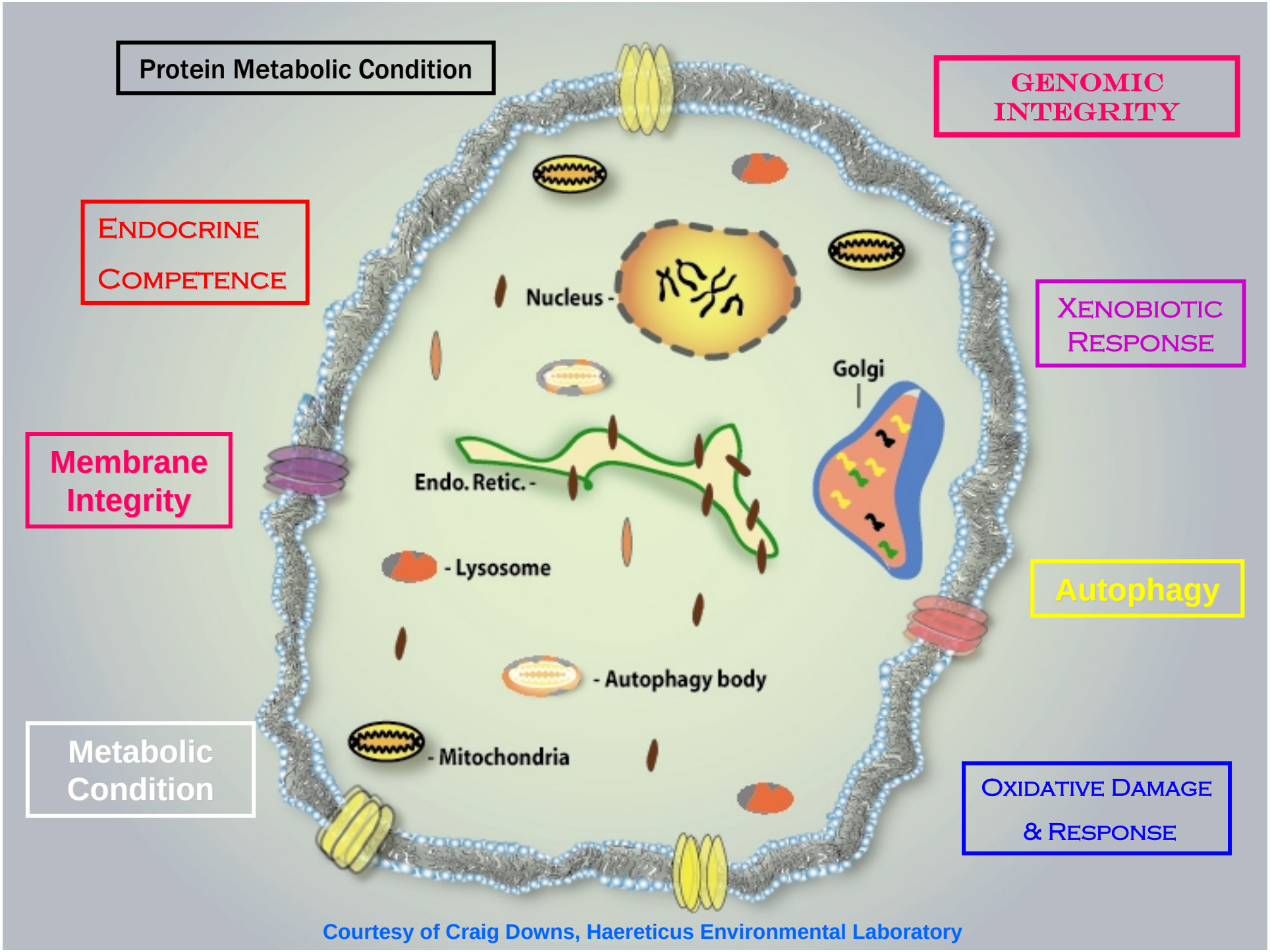
ReefBase

Coral Health & Disease

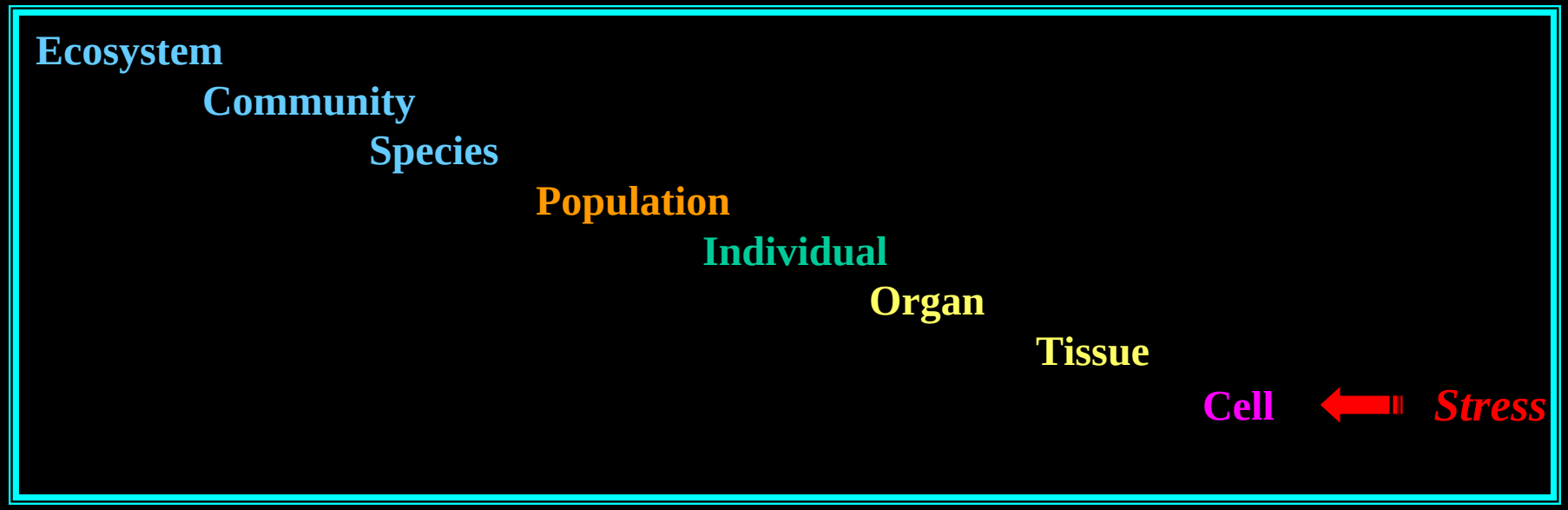



Coral
Scleractinian
Plant
(algae)
Animal
(coral)
Microbial
Community
Basic
Biology
Functional
Genomics &
Proteomics
Biochemistry
Genetics
Physiology
Stress Response
Defense
Detoxification

Cellular Diagnostics


Protein Metabolic Condition
GENOMIC INTEGRITY
ENDOCRINE COMPETENCE
XENOBIOTIC RESPONSE
Membrane Integrity
Autophagy
Metabolic Condition
OXIDATIVE DAMAGE & RESPONSE
Nucleus -
Golgi
Endo. Retic. -
- Lysosome
- Autophagy body
- Mitochondria
Courtesy of Craig Downs, Haereticus Environmental Laboratory

Project Approach



Community Assessments *(Fisher)*

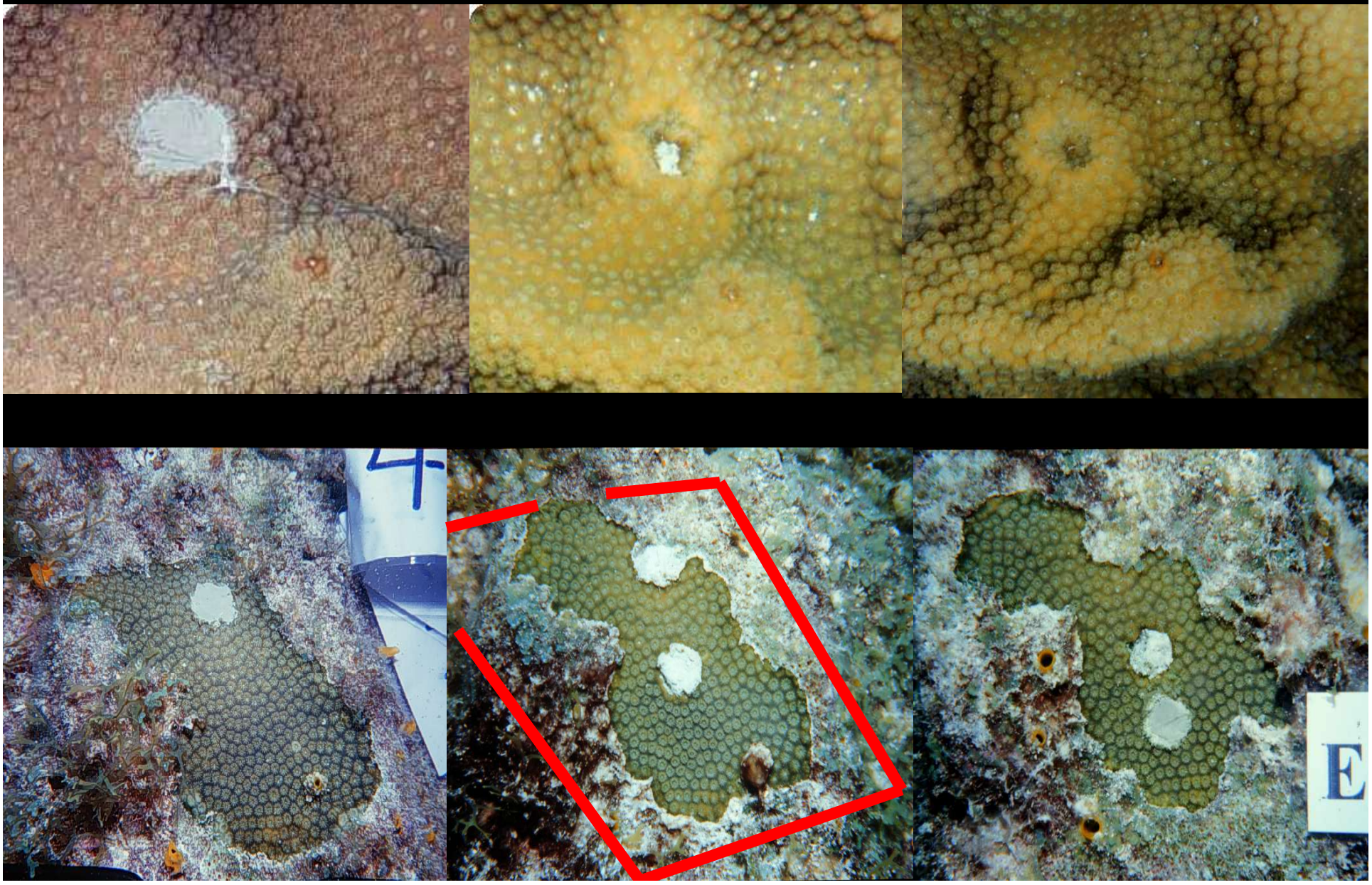
Foraminiferal Condition *(Hallock, Fisher)*

Coral Lesions and Regeneration *(Fisher)*

Cellular Diagnostic System (CDS)
(NOAA and EnVirtue)

Environmental Assessments
(Fisher and NOAA)

March → June → August



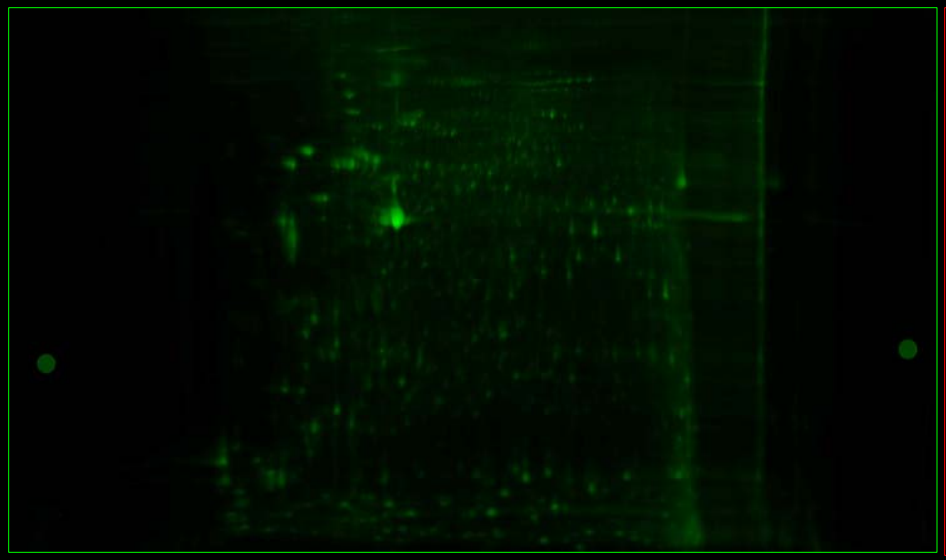
Proteomic Development
Biomarker Discovery

2-Dimensional Gel Electrophoresis can demonstrate differential changes in protein quantity and physiologically relevant modifications between samples of interest

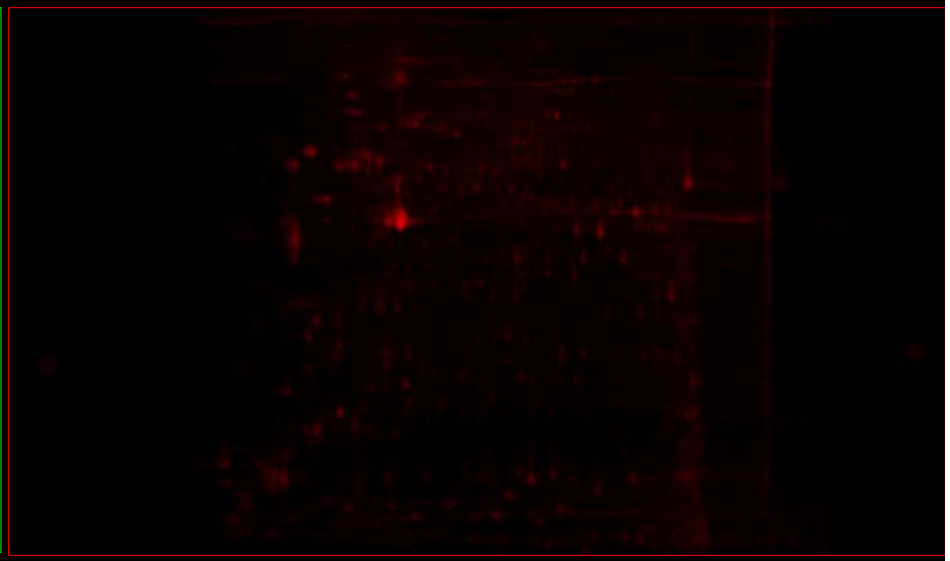
Mass spectrometry can be used to characterize differentially expressed or modified proteins

Scanned 2D gel

Healthy Control



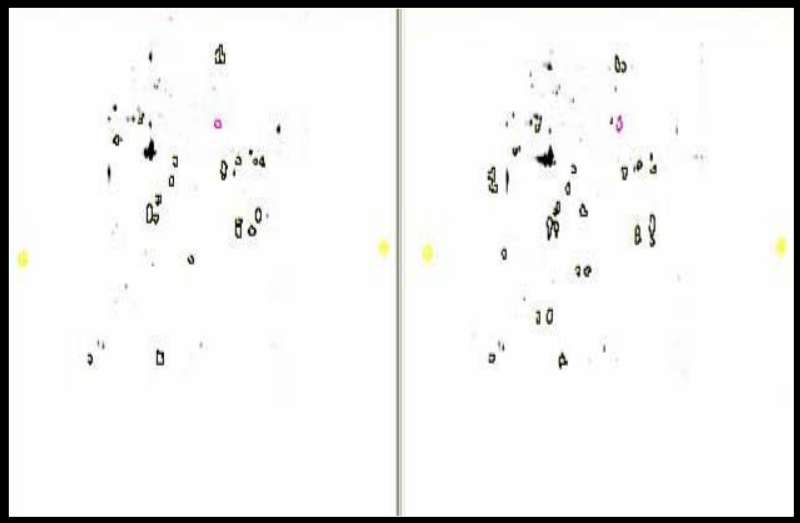
Diseased sample



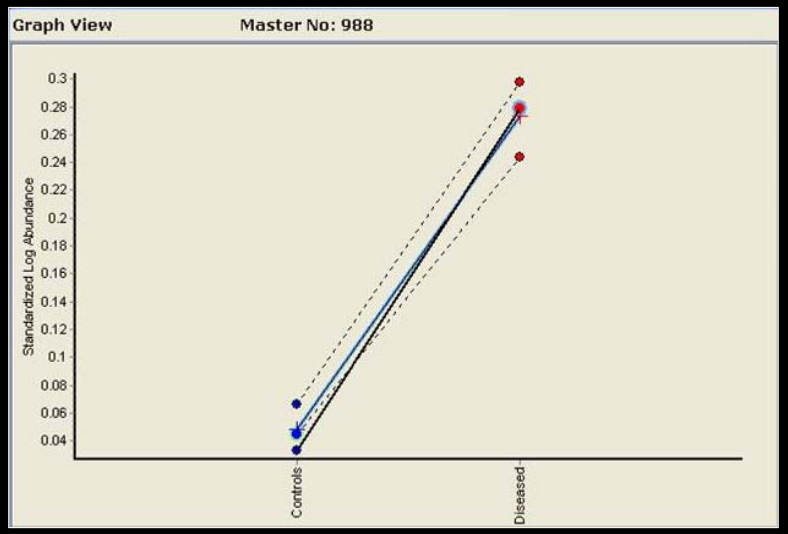
Overlay with samples and standard

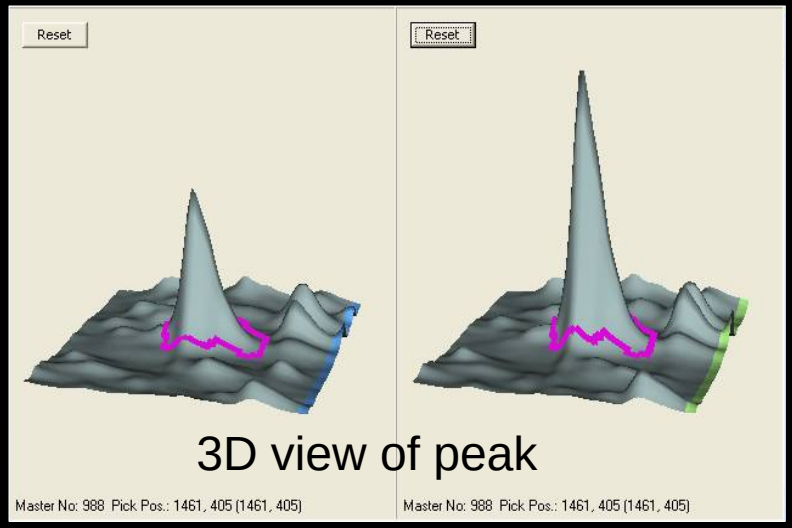
Processed 2D-gel

Gel view after analysis

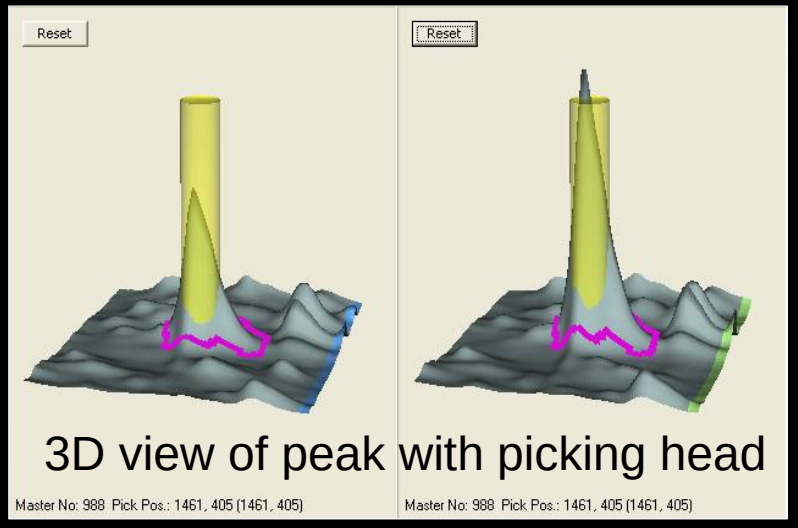


Relative protein levels





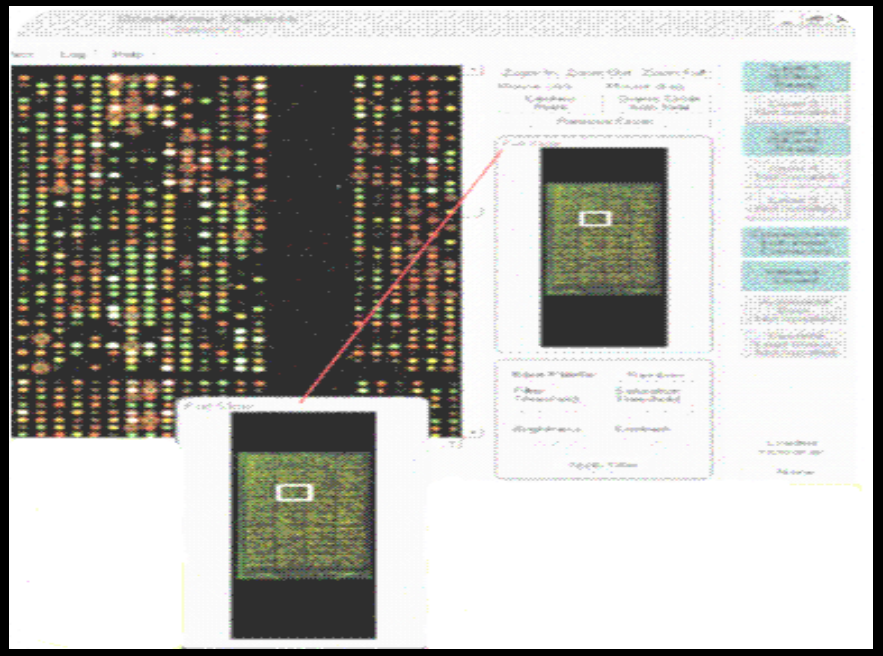
3D view of peak

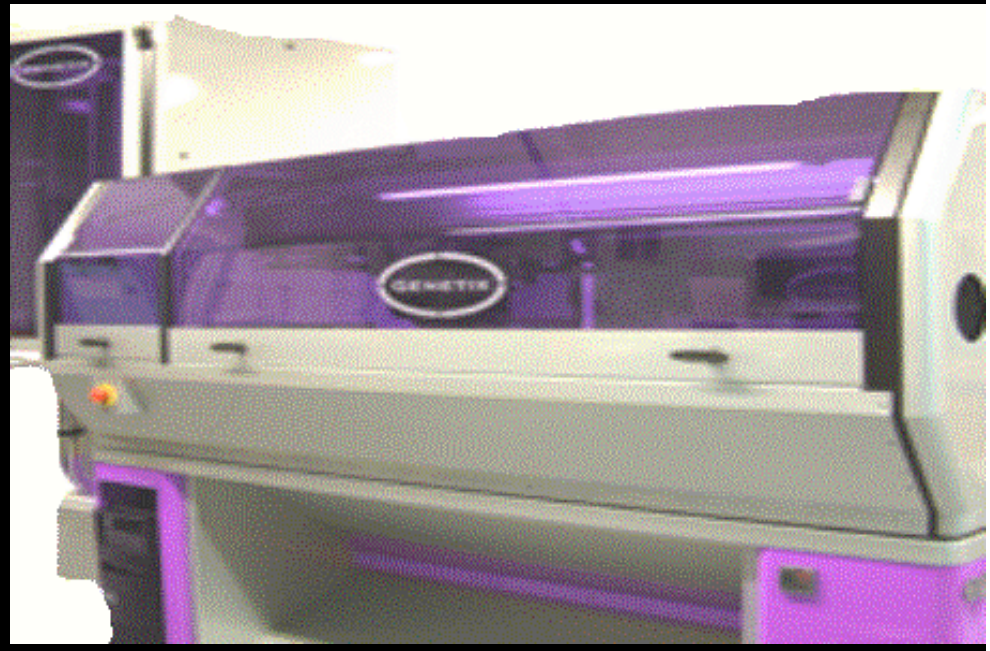


3D view of peak with picking head

Genomics


GENETIX
'Q' BOT
GENETIX




GENETIX

Genomic approach

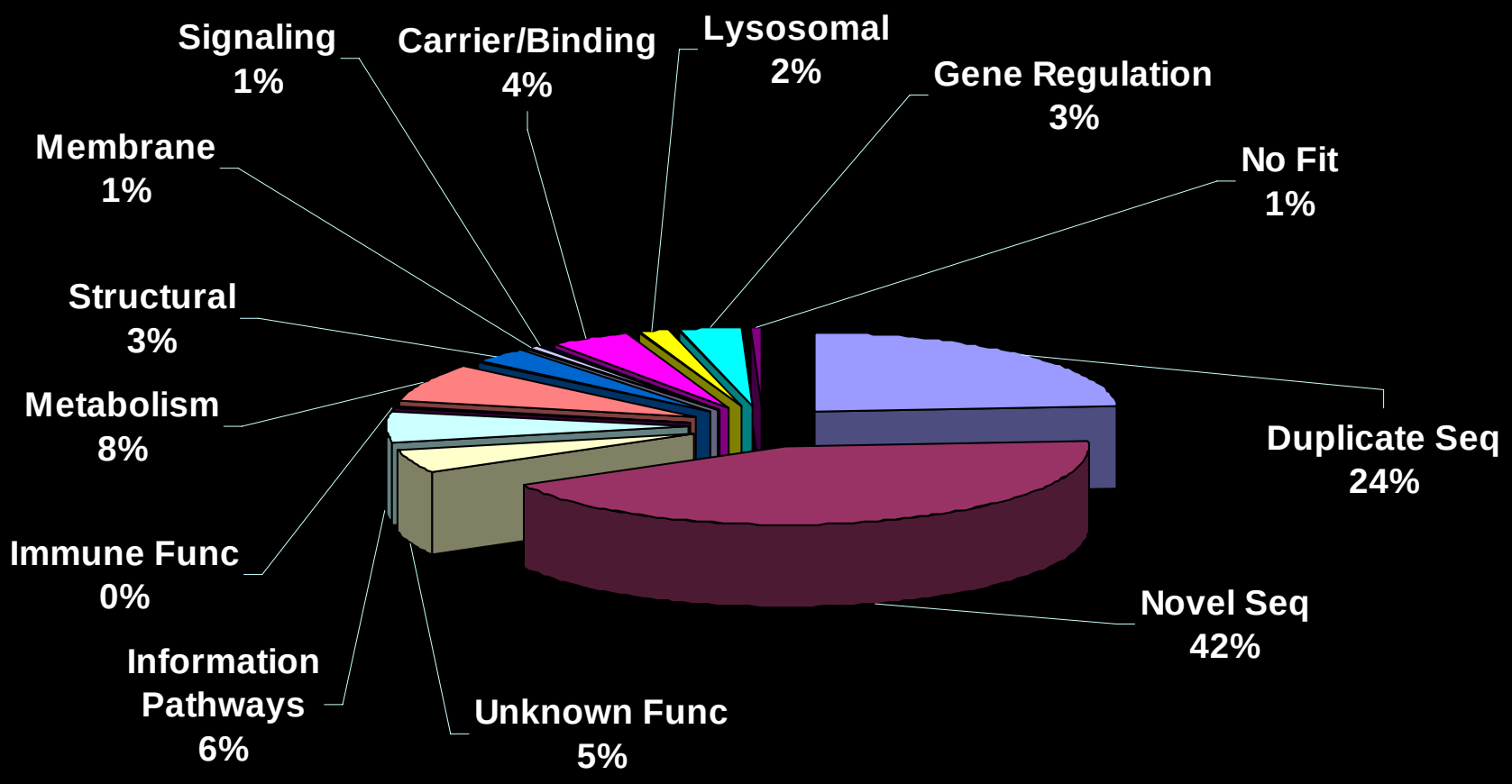
- Host-Pathogen-Environment interactions results in shifts in gene expression.
- Subtractive Library Construction and Characterization to Identify Genes of Interest
- Expressed Sequence Tags (ESTs) for Diagnostic Development

Summary of Coral EST Clones

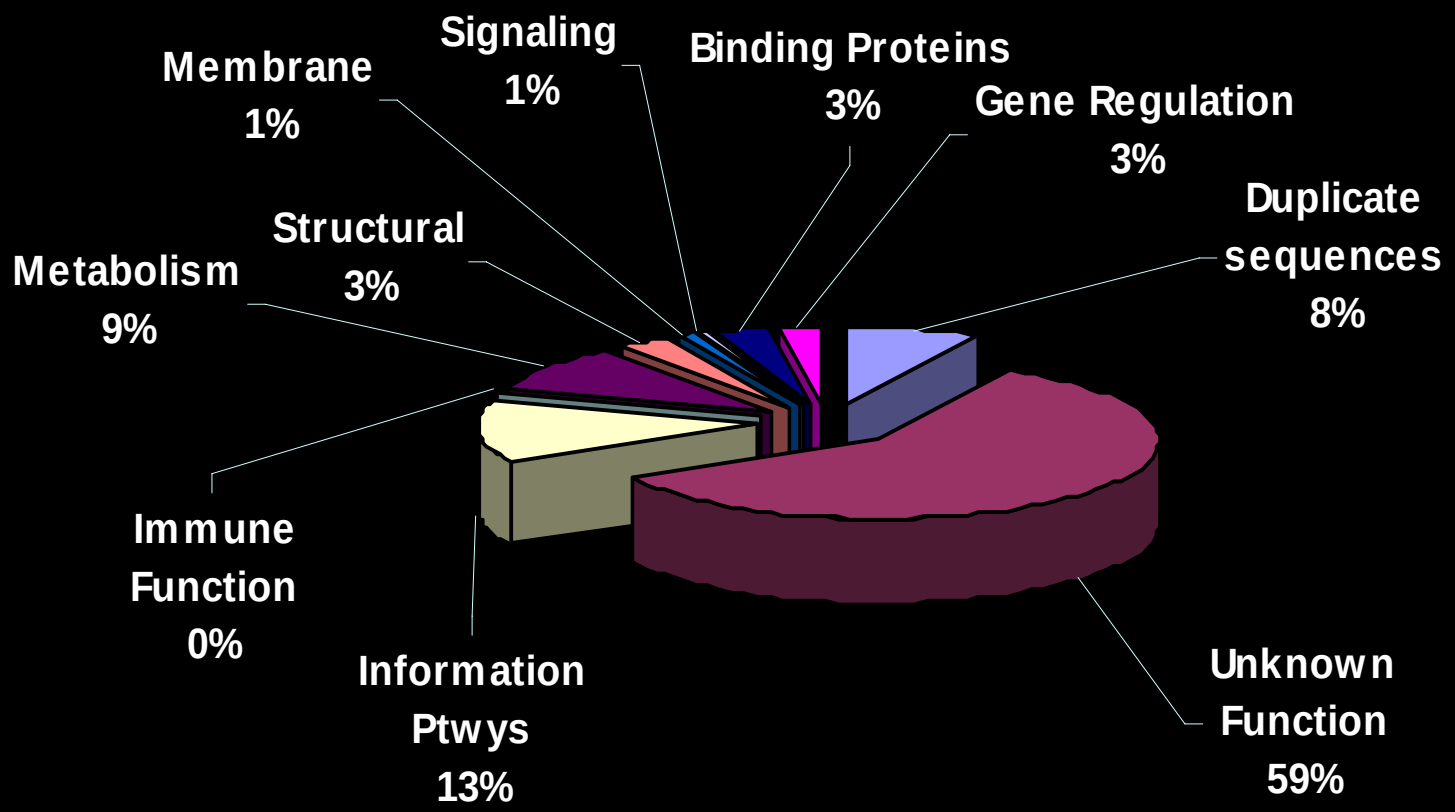
Species	# of ESTs
M. annularis	2467
O. varicosa	417
P. porites	247

Sequences available at **http://www.marinegenomics.org/**

Montastraea EST Library



Oculina EST Library

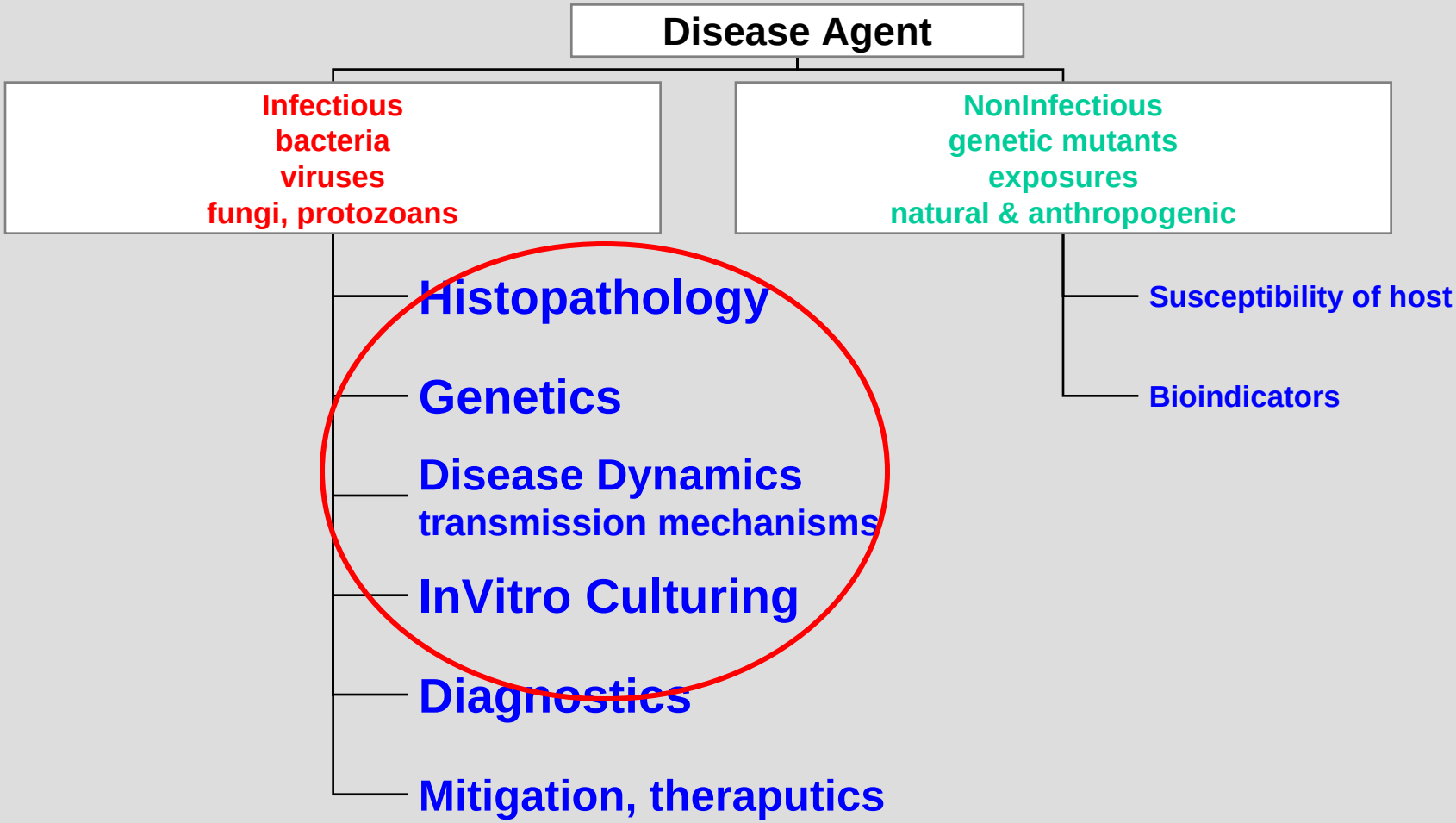


Coral Genome Sequencing

- **Coral genome sequencing: *Porites lobata & Acropora palmata***

  National Human Genome Research Institute
  (G. Ostrander, PI)

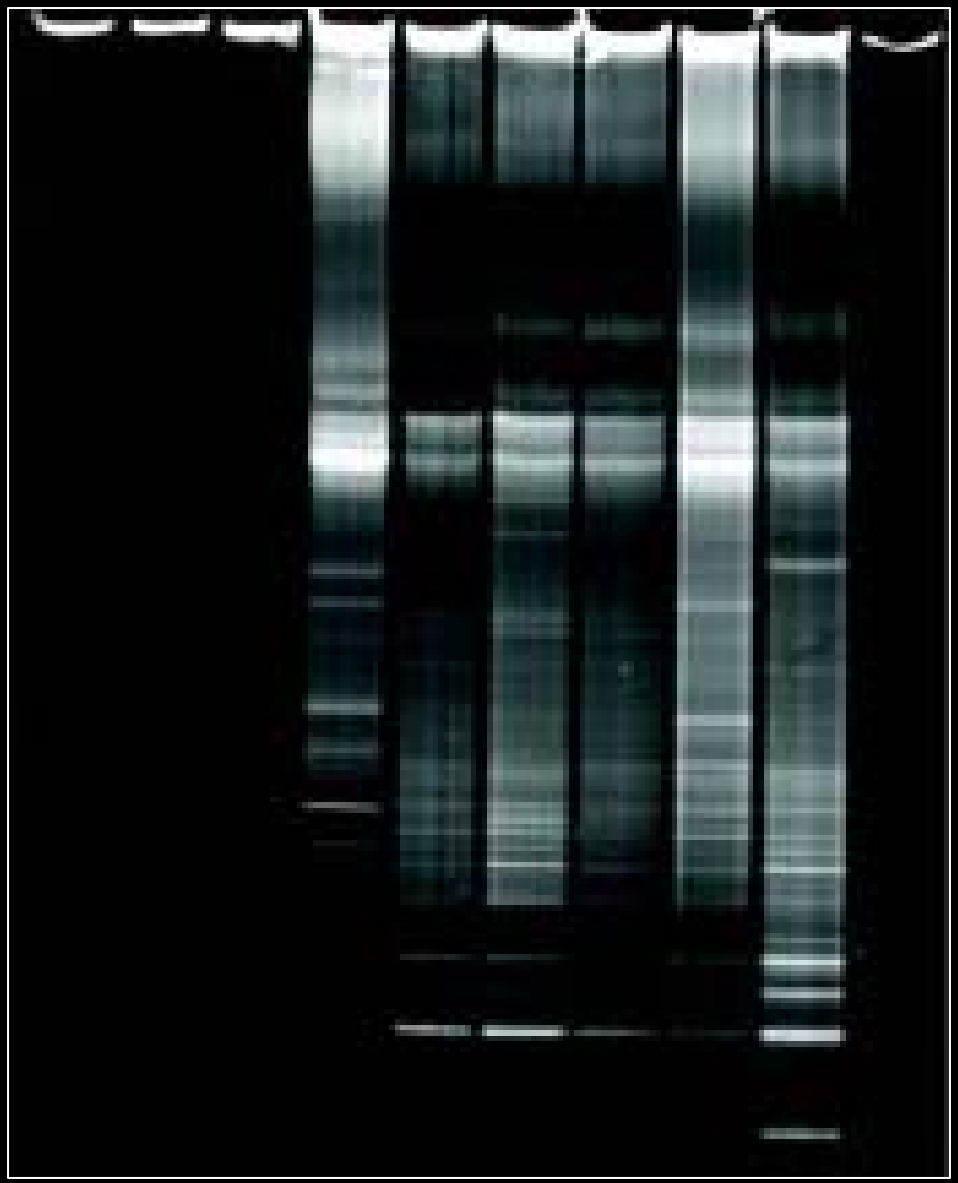
Microbial Community Analyses


Disease Agent
Infectious
bacteria
viruses
fungi, protozoans
NonInfectious
genetic mutants
exposures
natural & anthropogenic
Histopathology
Genetics
Disease Dynamics
transmission mechanisms
InVitro Culturing
Diagnostics
Mitigation, theraputics
Susceptibility of host
Bioindicators

Microbial Community Analyses

- **Microbial Ecology of Gorgonian Mucus- healthy and diseased & quorum sensing**
- **Microbial Community Analysis of Deep Sea Coral**
- **Establishing the validity of microbial community shifts as indicators of coral condition**
- **Investigating the role of intra-tissue bacterial aggregates in health and disease of Acropora**

DGGE



Microbial Diversity of Deep Water Coral

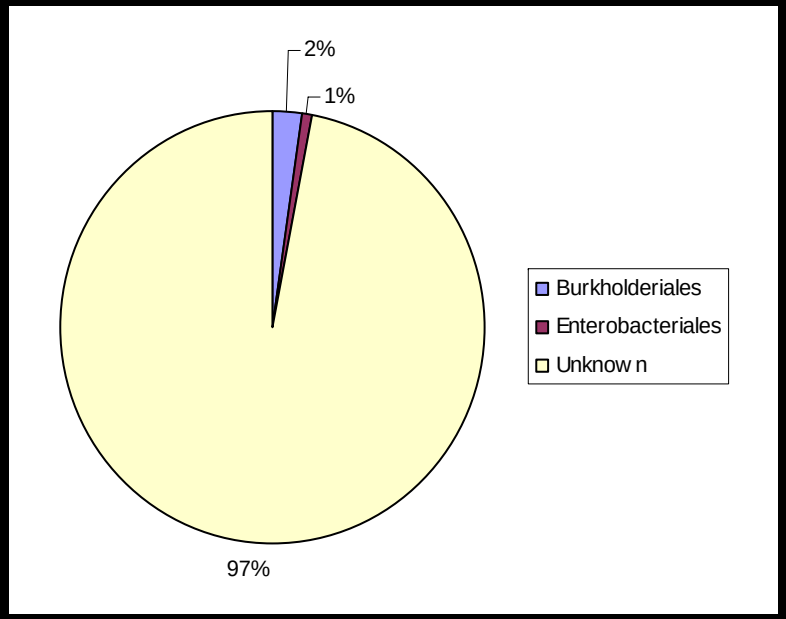
- *Fanellia* sp. a deep water gorgonian collected from the Adak Canyon off the coast of the Aleutian Islands
- Microbial communities assessed by 16s rDNA gene libraries
- Preliminary data supports the hypothesis that microbial diversity increases in response to stress or disease.

Healthy *Fanellia sp.*

'Diseased' or damaged *Fanellia* sp.

Coral Associated Microbial Community Analysis

A **Healthy *Fanellia* sp. (n=94) 80% conf**



B **Diseased/Damaged *Fanellia* sp. (n=94) 80% conf.**

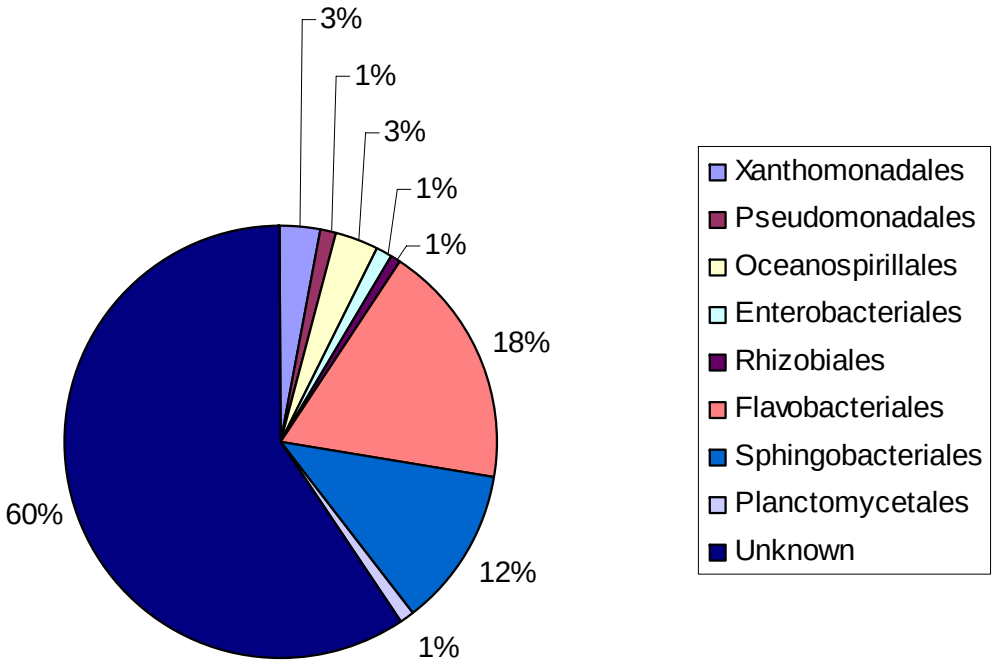
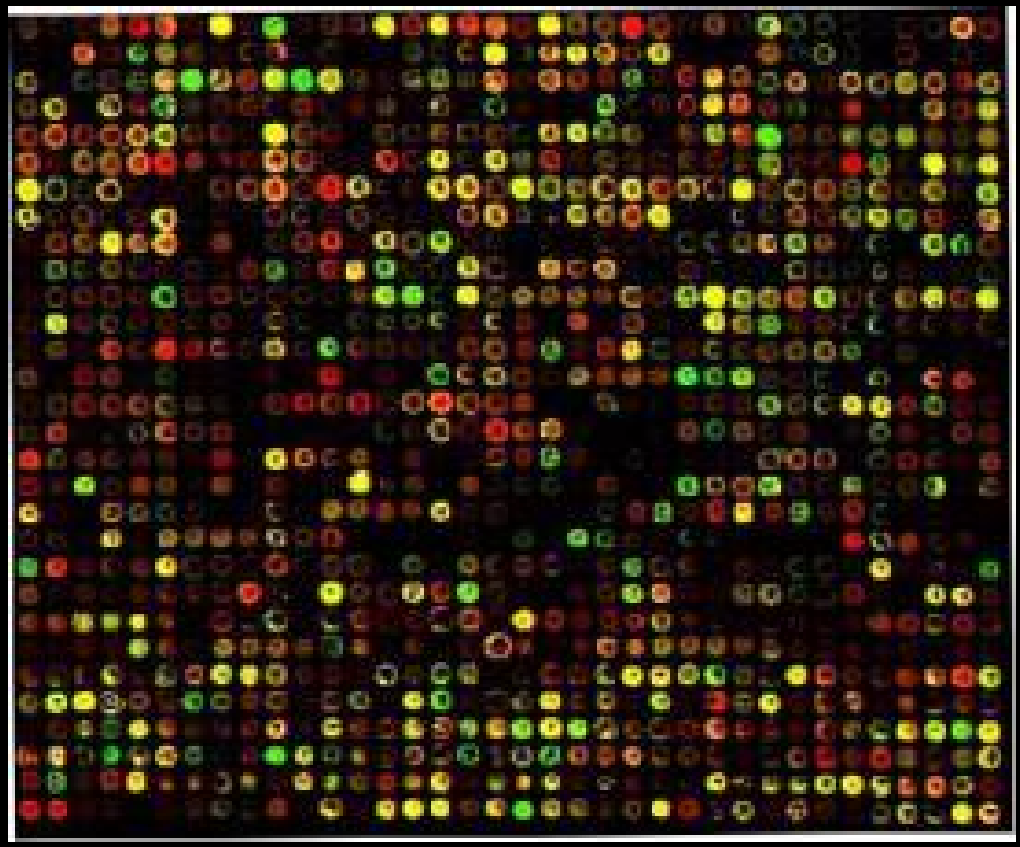


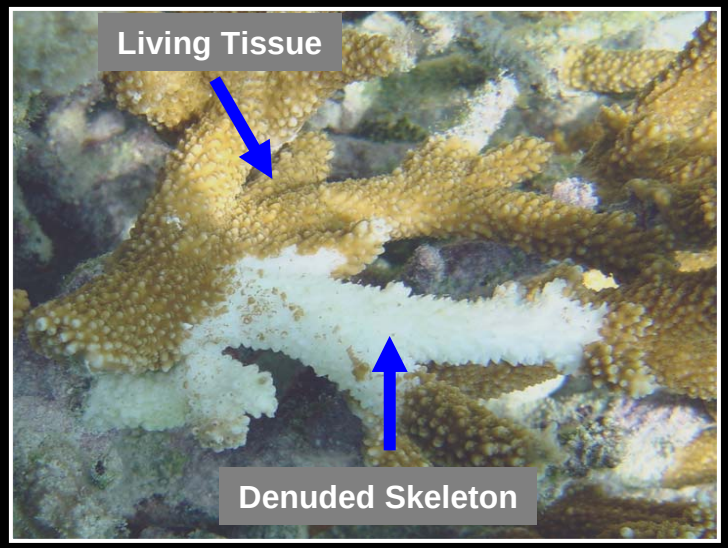
Fig 1. Percentages of 16s DNA clones (n=94) classified into phylogenic orders. **A**.) Microbial diversity of an apparently healthy sample of *Fanellia* sp. coral. **B**.) Microbial diversity of a damaged or possibly diseased *Fanellia* sp. coral. Data analized with the Ribosomal Database Project II classifier tool (Michigan State University) with an 80% confidence level (Cole, *et al.*, 2003).

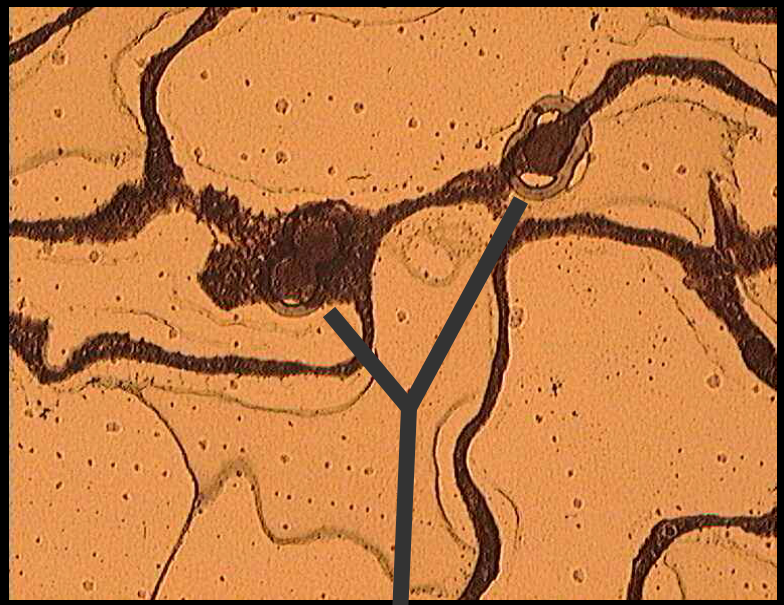
Functional Genomics

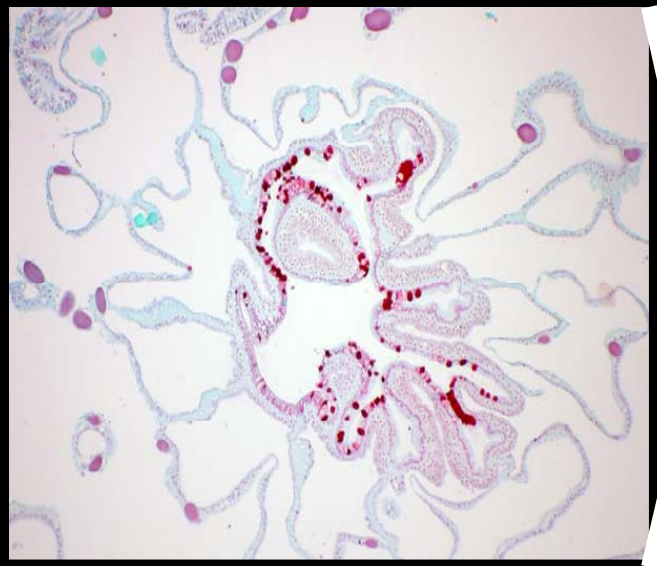
DNA microarray

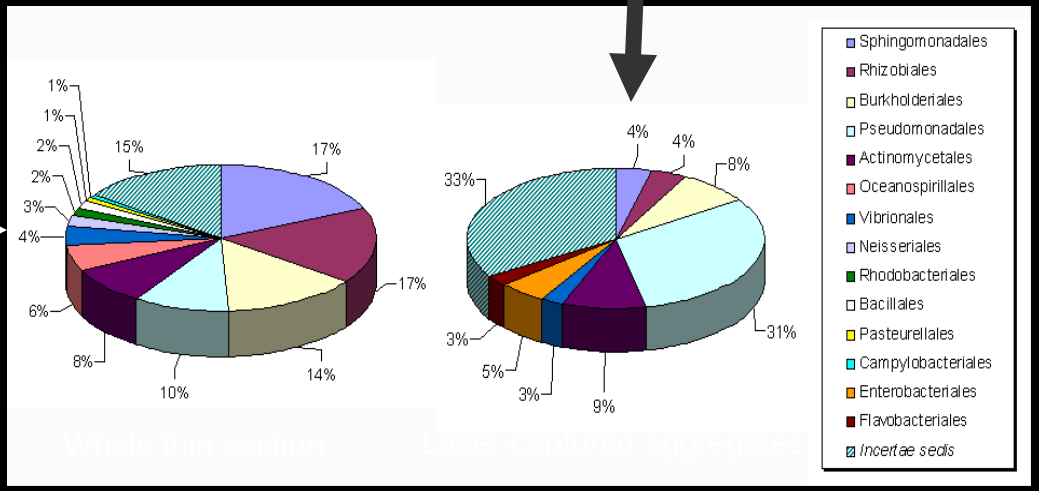


Acroporid coral mortality in the Florida Keys and Dry Tortugas









To better understand how to conserve coral reef ecosystems, we not only must determine their health on a community scale, but understand the underlying mechanisms on an molecular and cellular scale.